The Forty-Eighth Annual Report

OF THE

UNIVERSITY OF MARYLAND

Agricultural Experiment Station

College Park, Prince George County, Maryland

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The University of Maryland
Agricultural Experiment Station

STATION STAFF

Harry J. Patterson, D.Sc., Director.

AGRICULTURAL ECONOMICS.

S. H. DeVault, Ph.D., Agr. Econ.
Ralph Russell, M.S., Assistant.
Paul Walker, M.S., Assistant.
Arthur B. Hamilton, M.S., Assistant.

AGRICULTURAL ENGINEERING.

R. W. Carpenter, A.B., LL.B., Engineering.

AGRONOMY (CROPS AND SOILS).

† J. E. Metzger, B.S., A.M., Agronomist.
W. B. Kemp, Ph.D., Agron. (Genetics).
G. Eppley, M.S., Asso. (Crops).
O. C. Bruce, M.S., Asso. Soil Technologist.
R. P. Thomas, Ph.D., Soil Technologist.
E. H. Schmidt, M.S., Assistant (Soils).
H. B. Winant, M.S., Assistant (Soils).
R. G. Rothgeb, Ph.D., Asst. Plt. Breeding.
R. L. Sellman, B.S., Assistant.

ANIMAL AND DAIRY HUSBANDRY.

DeVoe Meade, Ph.D., Dairy and Animal Husbandman.
B. E. Carmichael, M.S., Animal Husbandman.
W. E. Hunt, M.S., Associate, Animal Husbandry.
L. W. Ingham, M.S., Associate (Dairy Production).
M. H. Berry, M.S., Assistant Dairy Husbandry.
H. L. Ayres, Dairy Mfg.
W. C. England, Ph.D., Asst. (Dairy Mfg.).

ANIMAL PATHOLOGY AND BACTERIOLOGY.

R. C. Reed, Ph.B., D.V.M., Pathologist.
** A. L. Brueckner, B.S., V.M.D. Associate Pathologist.
L. J. Poelma, D.V.M., M.S., Assistant.
H. M. Devolt, D.V.M., M.S., Assistant (Poultry)
C. L. Everson, D.V.M., Assistant.
** Alex. Gow, D.V.M., Assistant.
** C. R. Davis, M.S., D.V.M., Assistant
**Irwin Moulthrop, D.V.M., Assistant
M. T. Bartram, M.S., Assistant (Meat Curing).

BOTANY, PATHOLOGY, PHYSIOLOGY.

†† C. O. Appleman, Ph.D., Physiologist.
J. B. S. Norton, M.S., D.Sc., Pathologist.
C. E. Temple, M.S., Pathologist.
R. A. Jehle, Ph.D., Assoc. Pathologist.
Ronald Bamford, Ph.D., Assoc. Botanist.
Glenn A. Greathouse, Ph.D., Asst. Physiologist.
M. W. Parker, Ph.D., Assistant Physiologist.
J. W. Heuberger, Ph.D., Asst. Pathologist.
Neil W. Stuart, Ph.D., Asst. Physiologist.

ENTOMOLOGY.

E. N. Cory, Ph.D., Entomologist.
H. S. McConnell, M.S., Associate.
Geo. S. Langford, Ph.D., Associate.
L. P. Ditman, Ph.D., Assistant.
Geo. Abrams, M.S., Assistant (Bees).
C. Graham, M.S., Assistant.

HORTICULTURE.

J. H. Beaumont, Ph.D., Horticulturist.
T. H. White, M.S., Olericulturist and Floriculturist.
A. L. Schrader, Ph.D., Pomologist.
S. W. Wentworth, B.S., Associate Pomologist.
F. B. Lincoln, Ph.D., Assoc. Plant Propagation.
H. B. Cordner, Ph.D., Assistant Olericulturist.
W. A. Frazier, Ph.D., Assistant Canning Crops.
J. B. Blandford, Asst.-Farm Supt.

POULTRY HUSBANDRY.

R. H. Waite, B.S., Poultry Husbandman.
Geo. D. Quigley, B.S., Associate.

RIDGELY SUB-STATION

Albert White, B.S., Superintendent.

SEED INSPECTION.

F. S. Holmes, M.S., Inspector.
Ellen Emack, Assistant Analyst.
Olive Kelk, Assistant Analyst.
Elizabeth Shank, Assistant.

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* Agent U. S. Department of Agriculture.
† Assistant Director.
** Live Stock Sanitary Laboratory.
†† Dean of Graduate School.

The Station is located on the B. & O. R. R., City and Suburban Electric Car Line and the Baltimore-Washington Boulevard, eight miles north of Washington, D. C. Bell Telephone—Berwyn Exchange.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station in all its departments.

The Bulletins and Reports of the Station will be mailed free of charge, to all residents of the State who request them.

ADDRESS:

AGRICULTURAL EXPERIMENT STATION,
COLLEGE PARK, MARYLAND.

UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION

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THE FORTY-EIGHTH ANNUAL REPORT OF THE MARYLAND AGRICULTURAL EXPERIMENT STATION

For The Fiscal Year Ending June 30, 1935

By H. J. Patterson, Director

To the Governor of Maryland, the Board of Regents, and the President of the University of Maryland:

In compliance with the requirements of the Acts of Congress and the Maryland Legislature providing for the Agricultural Experiment Station, there is presented herewith brief statements as to the nature and progress of the research work and activities; a list of the active research projects, together with a financial statement showing the receipts and expenditures for the fiscal year. There is also appended copies of all the bulletins issued during the year. The summaries of the work of the various departments have in most part been prepared by the heads of the respective departments.

The economic conditions and national emergency programs have emphasized the need for research and brought to the Station many special projects which had to be conducted in a short time. These demands have been met, even with the smaller State appropriation, by many workers giving more hours of labor.

Economic conditions have caused the major interest of farmers to shift from quantity to quality and efficiency in production. The present research program is emphasizing the need for studying all factors which would help to lower the per unit cost of production and thus help increase the net returns for farm labor and investments. This condition has brought new and an

increased number of problems in plant and animal diseases, insect pests, soils, fertilizers, crop rotations, feeding animals, drainage, engineering, marketing, and economic questions. These have brought to the front new subjects and the need for men trained in fields which were unknown a few years ago—such as, land classification and uses, disease resistance, virus diseases, spray residues, vitamin carriers, tranportation and distribution of products. In order to have facts which would be helpful in the intelligent and proper handling of the emergency adjustment programs of the Federal Government, special surveys and researches have been conducted on the causes and needs for relief by rural people, rural housing, farm financing and mortgages, causes of tax delinquencies, land uses, crop adjustments and planning, living adjustments of farm families, small and subsistance farms, marketing problems of milk, poultry, fruit and vegetable producers. Application has already been made of some of the results obtained.

The research projects during the past year have developed new uses and applications of electricity to agriculture in milk pasteurization, soil sterilization, heating hotbeds and mushroom beds, and drying fruits and vegetables. Crop breeding has produced a smooth awned winter barley that has many improved qualities and is a high yielder. Advances have also been made during the year in breeding wheat, field corn, sweet corn and canning peas.

The eighteen departments and divisions of research have about one hundred fifty projects in progress. The major efforts and objectives of the projects are to establish fundamental principles and facts in the sciences underlying good farm practice. This class of work requires highly trained workers and years of patient endeavor. Some projects also require special apparatus which is expensive. Much of this kind of equipment has been added during the year in the departments of plant physiology, horticulture, bacteriology, and agronomy.

In addition to the usual lines of research, projects have been conducted in cooperation with the State Conservation Commission on crabs and oysters, with the U. S. Biological Survey on fur animals and diseases of game birds, and with the U. S. Bureau of Fisheries on fish meals and oils.

Publications

The publications issued during the year give reports of results obtained on some of the research projects being conducted. The following is a list of the bulletins published by the Station and the papers contributed by the members of the staff to scientific journals and society proceedings:

BULLETINS

Bulletin Number	Subject	Author	Pages	Copies Issued
365	Roadside Markets in Maryland	S. H. DeVault and R. F. Burdette	1-42	3,000
366	Studies on Firmness and Keeping Quality of Certain Fruits	E. S. Degman and J. H. Weinberger	43-100	2,500
367	A "Weigh-Back" System for Feeding Laying Hens	Roy H. Waite	101-120	2,500
368	Spray Residue Removal from Apples	M. H. Haller, J. H. Beaumont, C. R. Gross and H. W. Rusk	121-136	2,500
369	Equine Encephalomyelitis	A. L. Brueckner, L. J. Poelma, C. L. Everson and R. C. Reed	137-146	2,500
370	A Study of the Physical and Chemical Properties of Red Clover Roots in the Cold-Hardened and Unhardened Condition	Glenn A. Greathouse and Neil W. Stuart	147-166	2,500
371	Fruit Rotting Sclerotinias	John W. Heuberger	167-190	2,500
372	Nitrogenous Metabolism in Irish Potatoes During Storage	Neil W. Stuart and C. O. Appleman	191-214	2,500
373	Permanent Pastures in Maryland	Fred V. Grau	215-260	3,500
374	Physiological Studies on the Pathogenicity of Fusarium lycopersici Sacc. for the Tomato Plant	Paul Lewis Fisher	261-282	2,500
375	Responses of the Tomato in Solution Cultures with Deficiencies and Excesses of Certain Essential Elements.	Paul Lewis Fisher	283-298	2,500
376	Soybean Pasture for Hogs	B. E. Carmichael	299-312	2,500
377	Miscellaneous Studies on Poultry Grit	Roy H. Waite	313-336	3,000

PAPERS CONTRIBUTED TO SOCIETIES AND JOURNALS

Abrams, Geo. J.—Report of Extension Activities in Apiculture for 1934. State Beekeepers Assn.

Appleman, C. O.—The Hormone Problem in Plant Physiology. Amer. Soc. of Plant Physiologists, A. A. A. S., Pittsburgh, Dec. 27-Jan. 2, 1935.

Appleman, C. O.—Study of the Pectic Changes in the Potato Tuber at Different Stages of Growth and in Storage, by R. H. Dasteur and S. Agnihorti. Abstract written for Biological Abstracts.

Bamford, Ronald—Chromosome Numbers in Gladiolus. Jour. Agri. Res.

Bamford, Ronald—Chromosome Numbers in Gladiolus. Botanical Society of America, A. A. A. S., Pittsburgh, Dec. 27-Jan. 2, 1935.

Beaumont, J. H.—Satisfactory Washing Methods for Spray Residue Removal in the East. Md. State Hort. Soc. Rept., 37: 1935.

Beaumont, J. H.—Lead Residues and Their Removal as Influenced by Spray Programs. Proc. Amer. Soc. Hort. Sci., 32: 1934.

Beaumont, J. H.—Relative Value of Several Wetting Agents in Removing Lead Residues from Apples. Proc. Amer. Soc. Hort. Sci., 32: 1934.

Baumont, J. H.—Removal of Lead Residues from Apples in Maryland. Peninsula Hort. Soc. Rept., 24: No. 5, 1935.

Berry, M. H.—Soft Curd Milk Studies. Milk Plant Monthly, Oct. and Nov. issues, 1934.

Berry, M. H.—Variations in the Curd Tension of the Milk Throughout the Complete Lactation Period. American Dairy Science Assn., St. Paul, Minn., June 25, 1935.

Bruce, O. C.—Maryland Soils, Their Location and Productiveness. Md. Crop Improvement Assn. 1935.

Brueckner, A. L.—Horse Disease Experience in Maryland. Stockmen's Assn., Baltimore, Md., Jan. 9, 1935.

Brueckner, A. L.—Equine Encephalomyelitis. Md. Biological Society Meeting, College Park, Md., April 16, 1935.

Brueckner, A. L. and L. J. Poelma—Southern Md. Horse Breeder's Assn., Davidsonville, Md., August, 1935.

Cory E. N. and G. S. Langford—Sulfated Alcohols in Insecticides. J. E. E.

Cory, E. N.—The Codling Moth on the Eastern Shore. Peninsula Hort. Soc.

Cory, E. N.—Spray Calendar for 1935. State Horticultural Soc., Cir. 109.

DeVault, S. H.—Production and Marketing of Maryland Tobacco. Mimeographed report.

DeVault, S. H.—Brief on the Foreign Market Situation with Respect to Maryland Tobacco. Submitted to U. S. Tariff Commission.

DeVault, S. H.—Spiritual Living Promotes Health. The Messenger, April, 1935.

DeVault, S. H.—The Church and Economics. The Messenger, June, 1935.

DeVolt, H. M.—Vaccination Against Fowl Pox in Maryland. North Virginia Daily, Jan. 1935.

DeVolt, H. M.—The More Common Poultry Diseases. Queen Anne Poultry Assn., Centreville, Md., April 1, 1935.

DeVolt, H. M.—The Microscopic Enemies of the Domestic Fowl. Tricounty Dinner Club, Centreville, Md., April 9, 1935.

DeVolt H. M.—Principal Aspects of Poultry Disease Work. Montgomery County Poultry Assn., Rockville, Md., June 17, 1935.

DeVolt, H. M.—Vaccination of Chickens Against Fowl Pox. Prince George's County Poultry Assn. Upper Marlboro, Md., June 12, 1935.

Entomology, Plant Pathology and Horticultural Depts.—Spray Programs for Pears, Cherries, Plums, Grapes and Small Fruits, Bul. No. 74.

Eppley Geary—Seed Certification in Maryland. Md. Crop Imp. Assn., 1935.

Frazier, W. A.—A. Study of Some Factors Associated with the Occurence of Cracks in the Tomato Fruit. Proc. Amer. Soc. Hort. Sci., 32: 519-523, 1934.

Frazier, W. A.—Cracking of Tomato Fruits. Canning Age, June, 1935.

Grau, F. V.—Maryland Permanent Pastures. A Survey of Their Fertility Management and Botanical Composition. Md. Crop Imp. Assn., 1935.

Greathouse, Glenn A.—Unfreezable-freezable Water Equilibrium in Plant Tissues as Influenced by Sub-zero Temperatures. Plant Physiology.

Greathouse, Glenn A.—Unfreezable-freezable Water Equilibrium in Plant Tissues as Influenced by Sub-zero Temperatures. American Soc. of Plant Physiologists, A. A. A. S., Pittsburgh, Dec. 27-Jan. 2, 1935.

Greathouse, Glenn A. and Neil W. Stuart—A Study of the Physical and Chemical Properties of Red Clover Roots in the Cold Hardened and Unhardened Condition. Am. Soc. of Plt. Phys., A. A. A. S., Pittsburgh, Dec. 27-Jan. 2, 1935.

Harry, D. G., S. H. DeVault and W. P. Walker—Report of Committee on Taxation. Annual Report of Maryland State Grange, 1934.

Holmes, F. S.—Is the Introduction to the International Rules for Seed Testing Either Accurate or Adequate? Proc. of International Seed Testing Assn.

Krewatch, A. V.—A Progress Report on the Development of a Small Electric Milk Pasteurizer. Published Aug., 1934.

Langford and McConnell—Biology of Tomostethus multicinctus (Roh.), A Sawfly Attacking Ash. J. E. E.

Marth, P. C.—Response to Nitrogen Fertilizers Applied in Different Areas Under Rome Apple Trees. Proc. Amer. Soc. Hort. Sci., 32: 1934.

Marth, P. C.—Root Distribution of Rome and Stayman Apple Trees in Maryland. Proc. Amer. Soc. Hort. Sci., 32: 1934.

Metzger, J. E.—Rotations for Canning Crops. Tri State Canners, 1935.

Norton, J. B. S.—Maryland Ecology. Annual Conference of Biology Teachers, Baltimore, Md., April 12, 1935.

Parker, Marion W. and C. E. White—A Simple Sodium Press. Gen. Chem. Ed., Vol. 12, 232, May, 1935.

Parker, Marion W.—Physical and Chemical Properties of Soluble Polysaccharides in Sweet Corn. Plant Physiology.

Reed, R. C.—President's Address (An informal talk). Md. State Vet. Assn., Baltimore, Md., Feb. 7, 1935.

Rothgeb, R. G.—Sweet Corn Field Trials. Mimeographed form distributed at Canner's Conference, Feb. 26, 1935.

Schrader, A. Lee—Effect of Fall and Spring Applications of Various Nitrogen Fertilizers on Fruit Trees in Maryland. Proc. Amer. Soc. Hort. Sci., 32: 1934.

Schrader, A. Lee—Training and Pruning Peach Trees in Maryland. Peninsula Horticultural Soc. Rept., 24: No. 5, 1934.

Schrader, A. Lee—Will Girdling Kill an Apple Tree. Md. Fruit Grower, June, 1935.

Schrader, A. Lee—Comparisons of Fall, Spring, and Fall Plus Spring Applications of Various Nitrogen Fertilizers to Fruit Trees. Md. State Hort. Soc. Rept. 37: 57-60, 1935.

Schrader, A. Lee—Is Fruit Thinning Necessary in Maryland? Md. Fruit Grower, 5: No. 5, May, 1935.

Stuart, Neil W.—Determination of Amino Nitrogen in Plant Extracts. Plant Physiology, 10:1, January, 1935.

Stuart, Neil W.—A Source of Error in the Determination of Amino Nitrogen in Plant Extracts by the Van Slyke Method. Amer. Soc. of Plant Phys., A. A. A. S., Pittsburgh, Dec. 27-Jan. 2, 1935.

Stuart, Neil W.—The Effects of Increasing the Iodine Content of the Tomato Plant on Respiration and Enzymatic Activity, by F. Lyle Wynd. Abstract written for Biological Abstracts.

Thomas, R. P.—Testing Soils for Lime and Fertilizer Needs. Md. Crop Imp. Assn., Jan., 1935.

Thomas, R. P.—Rapid Soil Testing in Maryland. A. A. A. S., 1934-35, Pittsburgh, Pa.

Walker, W. P.—Certain Financial Aspects of Local Governments in Maryland. Mimeographed report.

Walker, W. P.—Tax Revenue Sources to the State Government of Maryland. Mimeographed report.

LIST OF ACTIVE PROJECTS, 1935-36

†Adams — *Purnell

Agricultural Economics:

*A-15.	The Supply and Distribution of Maryland Tobacco.
*A-18.	Organization and Business Analysis of Maryland Farms.
*A-18-a.	Insurance and Credit Problems of Maryland Farmers.
*A-18-e.	An Economic Study of Livestock Farms in Maryland.
*A-18-f.	An Economic Study of the Broiler Industry.
*A-18-g.	An Economic Analysis of the Baltimore Milk Market.
*A-19.	The Farm Tax Problem in Maryland.
*A-19-a.	Probable Economy and Increased Efficiency in Local County Government Through Redistricting of the State.
*A-26.	An Economic Analysis of the Present Status of the Marketing of Fruits and Vegetables by Motor Truck in New York City and Other Markets to which Maryland Produce Is Transported.
*A-26-a.	An Economic Study and Analysis of the Baltimore Fruit and Vegetable Market.
*A-27.	A Study of Basic Factors Related to Farm Planning in Maryland.

Agricultural Engineering:

R-3.	Development of a Small Electric Pasteurizer.
R-4.	Soil Sterilization.
R-5.	Temperature Control in Electric Heated Hot Beds.

Agronomy—Crops:

B-38.	Corn.
B-39.	Wheat.
B-41.	Barley.
B-42.	Hay, Forage and Pasture.
B-43.	Annual Legumes.
*B-44.	Sugar Corn Seed Production and Breeding.
B-45.	Miscellaneous Projects (dairy rotation).
*B-47.	Studies on the Reproductive Capacity of the Su (sugar) Factor in Relation to the Su (starch) Factor in Corn.
*B-48.	The Effective Sex-Ratio in Corn and Its Relation to Yield.

Agronomy—Soils:

†O-25.	Effect of Organic Matter on the Fertility of Leonardtown Loam.
O-27.	Field Studies of the Fertility Requirements and Management of Important Soil Types.
O-28.	Fertilizer Studies with Early Potatoes and Sweet Potatoes.
*O-31.	Soil Fertility Studies in Relation to Tobacco Brown Root Rot.
*O-33.	Efficiency of Soil Fertility Management.
*O-42.	Effects of Fertilizer on Fertility and Grass Population of Pastures.

Animal Husbandry:

*C- 6.	Study of Quality of Maryland Hams.
*C-10.	The Improvement of the Market Value and Carcass Quality of Thin Native Lambs.
C-13.	The Breeding of Flock Ewes Suitable for Early Lamb Production.

Biological Laboratory:

*D-28. A Study of the Methods of Transmission of the Causative Agent of Blackhead.
*D-31. A Study of the Economics of Clean and Infected Herds (Contagious Abortion-Bang's Disease).
*D-32. A Herd Survey of Reacting Animals (Bang's Disease) to Determine the Relation of the Titre of Agglutination to Udder Infection.
D-33a. A Study of the Urine of 100 Infected (Brucella Abortus) Guinea Pigs at the Time of Death.
D-33-b. A Study of the Feces of 100 Infected (Brucella Abortus) Guinea Pigs at the Time of Death.
D-34-a. The Examination of Urine of Cattle for Brucella Abortus.
D-34-b. The Examination of Feces of Cattle for Brucella Abortus.
D-35. Bovine Mastitis in Relation to Bang's Disease.
D-36. The Vaccination of Baby Chicks Against Fowl Pox.
D-37. A Study of So-called "Running Fits" in Dogs.

Botany:

F- 7. Chromosome Studies in the Genera **Ipomoea, Gladilous** and **Tulipa.**

Dairy Husbandry:

G- 3. Control of Contagious Abortion in the Experiment Station Dairy Herd.
G-11. Growth Data on Dairy Animals from Birth to Freshening Age.
G-14. The Comparative Feeding Value Between Steam Dried and Flame Dried Fishmeal in the Raising of Dairy Calves and Heifers.

Entomology:

H-21. Biology and Control of Some Greenhouse Pests.
H-22. Repelling Stable Flies.
†H-23. A Study of Laspeyresia molesta Busck in Maryland.
H-25. Biology and Control of the Peach Tree Borer.
H-26. Dusting Peach and Apple Trees for the Control of Insects and Diseases.
†H-27. Insecticide Investigations:
a. The Chemical, Physical and Insecticidal Properties of Pine Tar Creosotes and Some Allied Products, etc.
b. Testing of New Insecticides and Commercial Materials Based Thereon.
*H-28. Methods for the Control of the Potato Tuber Moth.
*H-29. Investigation and Biology of Insects Infesting Canning Crops:
a. Biology and Control of the Corn Earworm.
b. Biology and Control of the Mexican Bean Beetle.
c. Biology and Control of the Vinegar Gnat.
†H-30. Apple Insects:
a. Biology and Control of Apple Leafhoppers.
b. Biology and Control of the Plum Curculio.
c. Biology and Control of the Codling Moth.
d. Biology and Control of the Apple Leaf Skeletonizer.
e. Biology and Control of Apple Aphids.
H-34. A Study of the Insecticidal Properties of Pyrethrum and its Products.
H-35. Nursery Insects.
H-37. A Study of the Pollination of Cantaloupes.

Floriculture:

I-18. Sweet Peas. Varities and Novelties.
I-19. Breeding and Selection of Snapdragons.
I-20 Gladiolus. Tests of Winter Blooming Varieties.
I-21. Treatment of Greenhouse Soils. Sterilization.
I-24. Peonies. Factors Affecting Floriferousness.

Home Economics:

R- 5. Methods of Cooking as a Factor in Palatability of Hams.
R- 6. A Study to Determine the Palatability and Cost of Several Cooking Fats.
R- 7. The History of Home Economics in Maryland.
R- 8. Factors Influencing the Palatability and Food Value of Eggs.

Plant Pathology:

J-44. Plant Disease Survey.
J-45. Botanical Survey of Maryland.
J-46. Identification of Plants and Diseases.
J-48. Carnation Diseases.
J-50. Varities Resistant to Disease.
*J-60. Pea and Cow Root Rots.
J-69. Tobacco Diseases.
J-71. Apple Scab.
J-72. Potato Seed and Disease Control.
*J-78. Strawberry Root Diseases.
†J-79. Life History of Caryospora.

Plant Physiology:

†K- 7. Physiological and Biochemical Aspects of Vegetable Storage.
†K-17. A Physiological Study of the Resistance and Susceptibility of the Tomato Plant to Fusarium Wilt.
†K-18. A Physico-chemical Study of the Soluble Polysaccharides in Sweet Corn.
†K-19. Physiology of Cold Hardiness in Red Clover.

Plant Propagation:

*E- 1. Plant Propagation with Special Reference to Cuttings.

Pomology:

L-40. Breeding of Blight Resistant Pears.
L-45. Fruit Spur and Biennial Bearing Studies with Apples.
L-47. Effect of Shade on Horticultural Plants, Fruits, Vegetables and Flowers.
L-48. Fertilization of Apple Orchards.
L-50. Sod vs. Tillage for Apple Orchards.
L-52. The Fertilization of Strawberries.
L-53. The Effect of Bud and Spur Defoliation on Fruit Bud Formation.
L-54. The Influence of Pollination on Fruit Yields.
L-55. Experiments in Grape Training and Pruning.
L-56. Rejuvenation of Peach Orchards.
L-57. Peach Pruning Experiments.
L-58. The Breeding of Early Colored Grapes.
L-59. Variety Tests of Apples, Peaches, Pears, Plums and Cherries.
L-60. Variety Tests of Grapes and Strawberries.
L-61. Variety Tests of Bush Fruits.
L-62. Transplanting Studies with Trees.
L-63. Collection of Phenological Data.
L-64. Apple Breeding and Testing of New Seedlings.
*L-65. An Economic Study of Peach Cling Stone Canning Varieties.
*L-66. An Economic Study of Peach Planting Distances.
*L-67. A Study of Factors Affecting the Red Color of Apples.
*L-68. A Study of the Effect of Nitrogen and Other Fertilizers on the Firmness of Flesh, Shipping Quality, and Keeping Quality of Various Fruits.
L-69. Studies of the Effects of Different Nitrogenous Fertilizers on Orchard Fruits.
L-71. Removal of Spray Residues from Fruits and Vegetables.
L-72. Relations of Soil Moisture, Age, Size, Spacing, and Fertilization to Flower Differentiation Yield, and Quality of the Strawberry.

Poultry:

M-28. Egg Laying Competition—(1) Studies of Seasonal Distribution of Egg Production as Influenced by (a) Rate of Production (b) Feed Rations. (2) Studies on Mineral Consumption.
M-29. Tests of Special Methods for Drying and Pulverizing Poultry Manure as It Comes from the Droppings Boards.
M-30. A Controlled Test to Determine the Efficiency of Approved Good Management in the Control of Bacillary White Diarrhea.

Ridgely Farm:

S- 1. Growing Multiplication Plots of Mammoth Red Wheat for Distribution.
S- 2. The Use of Fertilizers in the Rotation of Corn, Wheat, Hay, and Tomatoes.
S- 3. Tests with Late Potatoes, New Varieties and Seedlings.
S- 4. Variety and Fertilizers Tests of Strawberries.
S- 5. Experiments with Sweet Potatoes, Cantaloupes, Multiplication of Types.
S- 6. Experiments with Garden Peas for Canning.
S- 7. Tests of Varieties of Tomatoes and Early Plants on Total Yield.
S- 8. The Effect of Lime With and Without Fertilizers and Manure.
S- 9. Tests of Different Kinds of Lime on Alfalfa.
S-10. Variety Tests of Corn, Wheat and Soybeans.
S-11. Tests of New Selections of Wheat.

Seed Inspection:

N- 7. Inspection of Seeds Sold Throughout the State Each Year.
N- 8. Laboratory Study of Samples Taken from Seeds Sold Throughout the State Each Year.
N- 9. Examination of Samples Submitted to the Laboratory Each Year.
N-10. Identification of Seeds Submitted to the Laboratory.
N-11. Studies of Observed Variations Among Germination Tests.
N-13. Economic Use of Seeds.

Tobacco Investigations:

P- 1. Tobacco Breeding and Variety Tests.
P- 2. Crop Rotation Tests with Tobacco.
P- 3. Effects of Crops on Yields of Succeeding Crops in the Rotation with Special Reference to Tobacco.
P- 4. Fertilizer Tests and Studies in the Nutrition Requirements of the Tobacco Plant, with Reference to Both Quality and Yield of Leaf Tobacco.
P- 5. Improved Methods of Handling Seed Beds, Including Steam Sterilization.
P- 6. Nutritional Deficiency Studies.

Vegetable Gardening:

*Q-58. Factors Influencing the Yield and Quality of Garden and Canning Peas.
Q-59. Rhubarb—Chemical Fertilizers with Especial Reference to Sulfate of Ammonia.
Q-60. Cantaloupes—Breeding and Selection.
Q-61-C. Sweet Potatoes—Best Size Roots for Plant Production and the Effect on Yields.

Q-61-D.	General Fertilizer Problems—Maintaining the fertility of the Land for Garden Crops.
Q-63.	Testing New Varieties and Strains of Vegetables.
Q-65.	Planting Distances and Different Formulas of Fertilizers for Asparagus.
*Q-66.	Spinach—The Selection of a Strain or Strains of Spinach that Will Meet the Market and Canners' Requirements.
*Q-67-A.	Tomatoes—Breeding and Selection of Varieties for Canning.
*Q-67-B.	Influence of Commercial Fertilizers with and without Green and Stable Manure on Tomatoes.
Q-67-C.	Tomatoes—Economic Value of Certain Cultural Conditions on the Yield and Quality of Raw and Manufactured Tomato Stock.
Q-68-A.	Yielding Capacity and Qualities of Different Varieties of Beans.
Q-70.	An Economic Study of Grade, Maturity, Composition and Canning Quality of Corn as Influenced by Seasonal and Cultural Conditions.
Q-71.	Potato Breeding and Inheritance.
Q-72.	A Study of Factors Affecting Development of Red Color and Quality of Canned and Raw Stock Tomatoes.
Q-73.	An Economic Study of Canning Crops in Rotation with Special Reference to Physiology and Pathology of Canning Peas.

Most of the fellowship and graduate students in the Experiment Station and College of Agriculture are assigned to some phase of the regular projects but a few take up special projects as per the following list:

Research Projects of Graduate Assistants

Agronomy:

The Function of Organic Matter in Maryland Soils.
Seed Production and Breeding of Sweet Corn.
Fertility Level of Maryland Pastures.
The Amount of Exchangeable Bases in Maryland Soils.
Soil Fertility Studies in Relation to Tobacco Brown Root Rot.

Bacteriology:

An Attempt to Determine the Factors which May Affect Guinea-pigs as Experimental Animals, Especially with Regard to Serological Tests. Also Experiments to Determine the Most Suitable Method of Preserving Complement.

A Comparison of the Various Media Now Being Used or Suggested for Use for the Isolation and Identification of E. coli from Milk. At the same time the results of this examination are being compared with the total bacterial count of milk.

Factors Affecting the Growth and Viability of Lactobacillus acidophilus.

Numbers and Kinds of Bacteria Found in Milk Drawn under Aseptic Precautions.

Growth and Viability of Pneumococci on Certain Media.

A Comparison of Some Differential Media for Escherichia-Aerobacter.

Bacterial Flora of Some Blattidae Species.

Horticulture:

Effect of Varying the Length of Day on Plant Growth and Chemical Composition.
The Fertilization of Strawberries.

ACCOMPLISHMENTS AND SIGNIFICANT CONTRIBUTIONS TOWARDS THE SOLUTION OF AGRICULTURAL PROBLEMS

Agricultural Economics

Work was conducted on nine projects during the year. Some of the accomplishments and significant contributions in selected projects are listed below.

Supply and Distribution of Tobacco

Three studies were completed: (1) A briefer report on the production and marketing of Maryland tobacco; (2) a detailed report covering the production, marketing, use and consumption of tobacco; and (3) a brief for the Tariff Commission on the foreign market situation with respect to Maryland tobacco. The first two reports served a useful purpose in connection with the enactment of legislation designed to improve the production, grading, sampling and marketing of tobacco. The third study was prepared specifically for the use of the Tariff Commission in the working out of reciprocal trade agreements between the United States and France that will be mutually beneficial to both countries.

Farm Organization and Management

The third year's record of a three-year study of 180 dairy farms and 100 poultry farms were obtained and analyzed, a new study of the organization and management of livestock farms was inaugurated and records were taken on 50 farms.

Labor incomes on the dairy farms varied from $4,829 to a deficit of $2,224, the average labor income being $233 per farm. Farms with plus labor incomes represented 60 per cent of the total farms studied, and those with minus labor incomes represented 40 per cent of the total. Farm receipts averaged $2,861 and farm expenses, $1,939, giving an average net farm income of $922. The cost of producing milk excluding brokerage was 18.9 cents a gallon; and the cost including brokerage was 19.9 cents a gallon. The average selling price per gallon was 20.0 cents.

Gross receipts on the poultry farms averaged $3,592 and expenses, $2,277, leaving a net farm income of $1,315. The average labor income was $877. Of the 100 farms studied, 87 made plus farm incomes and 71 made plus labor incomes. Feed was the most important item of expense, constituting 44.4 per cent of the total, while labor was second, making up 10.5 per cent of the total. The average cost of production, including non-cash expenses, was 19.6 cents a dozen; the actual cash per dozen was 14.7 cents. The average price received per dozen was 21.6 cents.

Farm Taxation

Financial Aspects of Local Government. A study was made for the State Planning Commission on "Certain Financial Aspects of Local Government in Maryland." The results were published as a mimeographed report containing 97 pages. As a result of this study, three State-wide laws pertaining to local government finances have been enacted. Several other similar bills were introduced at the 1935 General Assembly, but failed to pass. The subject matter of this report is divided into four parts: (1) Taxable bases and levies for local purposes; (2) uncollected taxes and tax collection procedure; (3) the debt situation and (4) recommendations.

Sources of Revenue for the State Government. A study was made and a mimeographed report issued early in 1935 on "Tax Revenue Sources for the State Government of Maryland." In addition to containing estimates of probable yield, the report presents arguments for and against the newer forms of taxation, such as the State income tax, retail sales tax, gross income tax, race track tax, inheritance tax, etc. This information was very useful to the General Assembly in considering possible new sources of State revenue.

Tax Delinquency. Data were collected on farm tax delinquency in Maryland through funds made available by the Civil Works Administration. Statistics were collected on over 30,000 pieces of property. A manuscript giving the results of this study is ready to be printed.

Probable Economy and Increased Efficiency in Local Governments of Maryland Through Redistricting the State. This project was begun in July, 1934. The objectives are: (1) To study local county government from the standpoint of present set-up, (2) cost of administration, and (3) to determine the probable economy and increased efficiency resulting from the redistricting of the taxable resources and the reorganization of the functions of county government. To our knowledge the Maryland study is the only one that has been made anywhere which attempts to measure the present efficiency of county government and the increased efficiency measured in terms of cost and service that would probably accrue through the consolidation of counties or the redistricting of the State into fewer local units.

The counties of Maryland have an assessed valuation of $919,000,000. This wealth varies in its distribution among the counties from $212,375,000 in Baltimore County to $5,768,899 in Calvert County. The levies in the several counties vary from $2,339,000 in Baltimore County to $63,719 in Calvert County. The total levy for all counties is approximately $10,163,000.

Among the several counties there appear inequalities in assessment for taxation purposes, inequalities in services rendered, overlapping and duplicating governmental services. Through a redistricting of the State it is believed that units of more competent size, and of greater efficiency in collecting funds, as well as disbursing funds, could be attained. In addition, added service could be given to some sections of the State that are unable to obtain these services under the present system.

A suggestion has been made that the State be divided into 8 new districts, instead of 23, for local government. A study made of one section of Maryland on the basis of 1934-35 data showed that the application of consolidation would effect a saving of approximately $119,000 annually. This represents a decrease of 6.25 per cent in the cost of government in this area under the present system.

During the year 1935-36, the other areas in the State will be studied and estimates will be made of the combined saving for the State as a whole.

Roadside Markets

A study was made of 173 markets; 147 of these were farmer-owned, of which 91 sold only produce grown on their own farms; 24 were owned by nonfarmers; and 2 were cooperative farm women's markets.

A tabulation of the sources of produce sold at farmer-owned markets shows that 82.5 per cent of the produce sold at permanent markets was homegrown; 11.4 per cent was grown nearby; and only 6.1 per cent was purchased in the city market. Of the produce sold at semi-permanent markets, 70.7 per cent was home-grown, while at the temporary markets home-grown products constituted 87.8 per cent of the total. Sales at permanent markets averaged $3,191 a year per market; at semi-permanent markets sales averaged $1,975; and at temporary markets sales averaged $230 per market. Bulletin No. 365 giving the results of the study was published during the year.

Agricultural Engineering

The time of the men in this department was devoted almost wholly to teaching and extension and no research funds used.

Some tests were made of low cost thermostats for electric soil heating. Some preliminary tests were made on the use of electric lights as a source of heat in hot beds. In August 1934 a progress report was published on the development of a small electric milk pasteurizer.

There are many research problems which should be given attention and which can not be taken up until funds are available for more help and facilities.

Agronomy

(*Crops and Soils*)

It is customary for the public to think of research largely in terms of the finished product. The study of some problems may be inaugurated and adequate results may be obtained in a comparatively short time. With other problems it is necessary to do years of painstaking research and experimentation before definite conclusions may be reached whereby an improved product or procedure may safely be recommended. The contributions of the Department have been unusually gratifying during 1935 in that the work in two very important projects has been completed. The first of these, winter barley hybrid, was a long time project. The second, a survey of Maryland pastures, was completed in slightly more than a year. By laying emphasis on these two projects this year, it must not be assumed that other work in progress is of less importance.

Barbless Winter Barley

The winter barley named Nobarb is a smooth awned, six rowed winter variety. It is the result from a cross between Tennessee Winter and Velvet made at the Station in 1926. Production tests have been made at College Park in nursery and twentieth acre plots, the latter for two years. The yields of the hybrid have been higher than for the Tennessee Winter which has been used as a standard. Not only has the hybrid yielded well but it seems to be equally as winter hardy as the rough awned barley and furthermore, several of the strains are much earlier in maturity. The new barley is more erect in the early stages and doubtless would produce very early and good grazing.

It has long been recognized that the chief deterrent to the use of winter barley is the presence of the barbs on the awns. These barbs are abrasive to the hands of the workers and are likely to cause infections in the mouths of animals if eaten. On the other hand the beard is desirable because it absorbs the impact of heads when handling the grain thus avoiding excessive shattering as is the case with smooth or hooded barley.

The feeding value of Maryland grown winter barley is about the same as for good oats. The straw of the new barley may be fed safely and like all barley straw it is relished by animals. Inasmuch as barley is seeded about a week earlier than wheat, it makes a splendid cover for the soil and prevents much sheet erosion.

In order to accumulate a comparatively large supply of seed and prevent unwarranted prices, the new barley will not be made available to farmers until 1936.

Maryland Pastures

The data upon which Bulletin No. 373 is based, were obtained during the summer of 1934. Pasture ratings were made on nearly 300 farms and 657 soil samples were collected and analyzed for their available plant nutrients. Except for their selection by soil series, the pastures for study were chosen at random in order to secure a fair measure of the variations of conditions which exist. Some of the pastures studied were more than 100 years old.

About one-half of the edible vegetation of Maryland permanent pastures is composed of Kentucky bluegrass and white clover. Exclusive of weeds, the remainder of the vegetation consists of varying amounts of orchard grass and crabgrass. For the state as a whole the weeds occupy about one-fourth of the entire acreage (total acreage 1930 census, 960,000 acres) devoted to pasture, that is only about three out of every four acres of permanent pasture affords grazing vegetation.

Analysis of the soil samples indicate that the pastures generally are deficient in lime and phosphorus. By classifying the records on the pastures that receive treatment, and comparing them with the untreated pastures for these nutritional elements, it was found that the percentage of bluegrass practically doubled where both lime and phosphorus were used. There is some evidence that manure alone improves pastures. The most outstanding benefit is secured on the pastures occupying shallow, steep and sandy soils. Manure and phosphorus together are very effective in the improvement of pastures. In most instances fall treatment with fertilizer is to be preferred to spring applications.

From a management standpoint the investigation has made important contributions on three controllable items. First, the time and amount of grazing. Many pastures are over-grazed indicating the need for either more pasture area or higher production on the present fields. In some instances pastures are allowed to become too mature before cattle are turned out to graze. Secondly, a large percentage of the weeds would be destroyed if the pastures were mown once in June and again in late August. Thirdly, lime and fertilizer are as important on pastures as on cultivated fields. A determination of these requirements should be made frequently and it should be kept in mind that the amount of edible forage on a pasture is largely dependent upon these factors.

Good pastures properly fertilized and managed can be made an important factor in the efficient and economical production of milk and meat.

Other Projects

The sugar corn work has been especially helpful to the growers. The tests of strains and the development of new hybrids are especially promising. In addition the inheritance studies of starches of varying qualities have given a new basis for improvement work.

In the cultivated crops convincing proof has been found, especially potatoes, that highly acid fertilizers are very undesirable and may depress yields, in a season of low rainfall, to less than one-fourth that obtained with the same fertilizer ingredients if made neutral with a suitable form of lime.

A long time test of tomato fertilization indicates that phosphorus and organic matter are the chief factors in yield control. It may be desirable to revise somewhat the fertilizer recommendations for this crop.

Animal and Dairy Husbandry

Some Curing and Storing Procedures Affecting the Aging of Hams

Work has been continued during the current year with the curing of hams and with the aging of hams at room temperature and under controlled temperature conditions. As a result of this work the following conclusions were drawn:

In curing, the brine-cured hams gained weight, while the dry-cured ones lost weight; the fat and the thin hams did not show any significant differences in per cent shrink; the per cent of shrink of brine-cured and of dry-cured hams was about the same at the end of the eight-week aging period; the per cent shrink of the tallow-covered hams was less at the end of the same period; the per cent shrinkage of the cooked dry-cured ham was less than that of the brine-cured ham. The per cent shrink of the cooked tallow-coated hams was the largest of the series; the per cent smoking shrink was greater with hams smoked immediately after curing than with those smoked after aging; smoking after aging gave hams a very pleasing appearance, and the uncooked hams had a pronounced smoky aroma; nothing was gained, from the standpoint of flavor of cooked hams, by smoking after aging; three days per pound was about the minimum length of time of cure required for brine-cured hams and about two days per pound for dry-cured; the strength of cure should be somewhat proportional to the storage temperatures of hams; there is not much difference in the palatability of dry-cured and brine-cured hams; tallow-covered hams did not develop a desirable flavor or texture; white flecking did not occure in hams aged in the incubator during the experiment; the flavor of incubator-cured

hams is much superior to that of fresh-cured hams; incubator hams have not been infested with skipper flies while in the incubator at 42° C.

Raising Dairy Calves on a Minimum Amount of Whole Milk

During the past year a group of 12 heifer calves from the Station herd were raised on a minimum amount of whole milk. For the first two weeks of age not over 10 pounds of whole milk were fed daily per calf. From two weeks to one month of age the whole milk was gradually replaced by skimmilk. From one month to five months of age not over 10 pounds of skimmilk, (9 pounds water and 1 pound skimmilk powder) were fed daily per calf. The calves were fed all of the clover hay and grain (up to five pounds daily) that they would consume. The grain ration consisted of 100 pounds bran, 100 pounds corn meal, 100 pounds ground oats, 50 pounds fishmeal, and 50 pounds linseed oil meal.

The group made an average daily gain of 1.15 pounds per calf. An average daily gain of this amount is considered very satisfactory for a normal group of calves raised under a minimum milk feeding plan.

The first results obtained on growth data on dairy animals from birth to freshening age in the Experiment Station herd are as follows:

Average Weight by Breeds

Age	*Ayrshire*	*Jersey*	*Holstein*	*Guernsey*
Birth	74.5	57.9	86.5	73.0
6 Months	292.9	228.4	330.7	260.6
12 Months	531.0	441.1	547.5	465.0
18 Months	712.1	570.8	719.1	616.1
24 Months	840.0	688.5	891.6	768.3
28 Months	975.0	830.0	955.0	960.0

In the course of the next few years enough growth data will be obtained to set up a normal growth standard for dairy animals raised under average farm conditions in Maryland.

Results of Feeding Trials with Heifers

A 120-day feeding trial with two groups of eight heifers each comparing the feeding value of steam dried and flame dried menhaden fishmeal was conducted during the year. This type of work will be carried on further to verify results.

Group feeding was practiced throughout the trial. Six pounds of clover hay (U. S. No. 2 grade), two pounds of ground yellow corn, and one pound of wheat bran, plus one pound of fishmeal were fed daily per heifer. Rock salt was kept before the animals in their feeding troughs. Fresh water was accessible at all times.

The average initial weight per heifer in each group was approximately 434 pounds. During the 120-day trial the group receiving steam dried fishmeal made an average daily gain of .94 pounds, the flame dried group 1.03 pounds.

The group fed the flame dried fishmeal was in a fine condition of flesh and presented a very smooth, thrifty appearance throughout the trial. The heifers in the group receiving the steam dried fishmeal were in a poor state of flesh at the end of the trial and presented a very rough, unthrifty appearance. No definite reason could be ascertained for this lack of flesh and general unthrifty appearance.

Some Factors Influencing the Whipping Properties of Cream and the Stability of the Finished Product

A study of some of the factors influencing the whipping properties of cream and the stability of the finished product has been pursued. As a result of the investigations carried on under the conditions of this experiment, conclusions seem warranted that:

The average volume of the fat globules in the Ayrshire and Guernsey cream in terms of cubic microns was found to be 10.59 and 16.29, respectively; on the average, it took nearly 30 per cent longer to whip Ayrshire cream than it did to whip Guernsey cream. Also, the drainage from the Ayrshire whipped cream contained about 1.77 times as much fat as the drainage from the Guernsey whipped cream; the stability of whipped cream, as measured by the drainage, was not decreased by storing at 52° F. as compared to storing at 40° F.; the correct amount of sodium alginate to add to cream to increase the stability of the finished product was found to be 0.20-0.25 per cent; when gelatin was used to increase the stability of the whipped cream, 0.35 per cent proved satisfactory; gelatin proved more effective in increasing the stability of whipped cream than did sodium alginate; the overrun was decreased when either sodium alginate or gelatin was added to the cream; when gelatin was added the body of the whipped cream had a high gloss and was somewhat soggy, whereas the body of whipped cream containing sodium alginate was scarcely discernible from cream containing no stabilizer; the air whip is much to be preferred to the turbine type of whipper for the commercial production of whipped cream.

Factors Affecting the Sale of Dairy Products at Roadside Markets in Maryland

During the summer of 1934 a survey study of thirteen dairy roadside markets in Maryland was conducted. From data obtained in this study it was found that:

Eight of these markets are permanent, remaining open twelve months of the year. Five are semi-permanent, being open from four to nine months; the buildings at most of the markets are in good repair, having been built within the last six years. This adds to the attractiveness of most markets; great care should be taken in choosing a location for a market. Markets located at crossroads and on straight level roads have the best location; the parking space at markets is of major importance. A few markets have inadequate parking facilities; the number and type of vehicles passing a market affects sales to a considerable extent. Stops at markets averaged from 2.6 per cent of the passing traffic for one market to 6.2 per cent for another market; most markets may be criticized for not keeping adequate records. All markets should keep records of the products sold as a check on business; only four markets maintain routes in connection with their retail business. Seven sell at retail and over the counter only. Six make deliveries; eleven markets fill pints and quarts of ice cream from the hardened cream. The other two fill the packages direct from the freezer. At these last two markets complaints are often registered as to the poor quality or the light weight of the packages filled direct from the freezer; prices vary considerably among the various markets, this indicates a lack of uniformity in the method of setting the price; ten markets produce all their raw materials; February is usually the low month for sales; July the high month. Sunday and Saturday are the best days of the week for sales; small markets, closing early, usually have the highest sales during mid afternoon. Those markets remaining open until twelve o'clock at night report that more than half of their sales occur after 6.00 P. M.; the sale of dairy products is greatly affected by climatic conditions; advertising is one of the main weak points of dairy roadside markets in Maryland. Several markets could benefit by the erection of new signs.

Soft Curd Milk Studies

Curd tension studies that have been carried on at this Station during the current and preceding year have established the following points with reference to the question of curd tension:

The curd hardness of milk was not affected by holding milk in a cooler at approximately 40° F. over a period of several days when the acidity in the milk did not increase to any appreciable extent; there was not a great variation in the curd hardness of the milk between milkings of the same day or consecutive days; colostrum has a high curd tension; the freezing of milk had a hardening effect upon the curd; viscolization pressures of 3000 to 5000 pounds were required to render hard curd milk (50 to 112 grams) a soft curd milk. The higher the curd tension of the

original milk the greater was the percentage reduction of curd tension after viscolization; the ordinary pasteurization temperatures showed no effect on the curd character of the milk. A temperature of 160° F. for a heating period as long as 30 minutes failed to render milk with ordinary curd hardness (30 to 80 grams) a soft curd product. A temperature of 180° F. had a marked softening effect on the curd. Milk with ordinary curd tension held at this temperature for 15 minutes was rendered a soft curd milk. Heating milk with a curd tension of 30 to 80 grams to the boiling point also usually softened the curd to below 30 grams curd tension; the curd character of the milk in reference to curd tension is fairly uniform throughout the lactation period with the exception of the first few days following freshening when it may be very hard; in feeding trials with rats, natural soft curd milk had no tendency to produce rats with larger gains in weight than did normal hard curd milk or normal hard curd milk rendered a soft curd milk by heat or pressure. Neither was the consumption of natural soft curd milk greater than normal hard curd milk; that an abortion during the lactation period does not appear to have any effect upon the curd tension of the milk; that there is not a seasonal variation in the curd tension of the milk; that the average curd tension of the milk produced in one lactation period may vary widely from the curd tension of that produced in another.

Animal Pathology and Bacteriology

At the present time, this Department has no active cooperative research projects, but we do have several problems which are being worked upon by graduate students and members of the staff, each of which has as its objective a solution of some problem connected with the study and diagnosis of animal disease or of methods of improving some dairy products with regard to sanitation or manufacture.

Two theses presented by graduate students who received Masters Degrees, had more to do with public health work than agriculture, while the other four problems have direct bearing upon animal disease study or are directly concerned with the care, handling and manufacture of dairy products.

Following is a brief statement of the aims of the four projects with an agricultural bearing:

(a) An attempt is being made to determine the factors which may affect guinea-pigs as experimental animals, especially with regard to serological tests. The purpose of the experiment is to show the number of factors that may affect the potency of guinea-pig complement, together with some physical measurements as a possible means of determining the titre of such serum.

Some of the factors to be worked out will be the effect of sex, age, weight, inherited characteristics, pooling of complement before and after clotting, nutrition, etc. The physical measurements are to include surface tension, viscosity and bound and free water. Also a number of experiments are to be conducted with the hope of determining a suitable method for the preservation of complement. The work will require a year or more to complete.

(b) A comparison is being made of the various media now being used or recommended for use for the isolation and identification of E. coli from milk. At the same time the results of this examination are being compared with the total bacterial count of the milk.

The aim of the investigation is to select or devise a medium which shall give the most rapid and accurate determination of E. coli in milk, and to study the desirability of using the E. coli content of milk as a basis for estimating its sanitary quality as well as the efficiency of pasteurization.

(c) A study of the factors affecting the growth of Lactobacillus acidophilus is in progress. The purpose of this work is to determine the factors which affect the growth of Lactobacillus acidophilus, hoping to increase the number of organisms in the final product. The nature of the work is to attempt to increase the number of organisms and to retain the viability of those present. Such factors as the effect and control of acidity and pH, the effect of surface tension, CO_2 oxidation and reduction, and the addition of growth-promoting substances. This work has been in progress for some time with the hope of being completed during the next year.

(d) One graduate student presented a thesis on "A Comparison of Some Differential Media for the Escherichia-Aerobacter Groups" as part requirement for her Master's Degree this year. This study revealed some of the weaknesses of the differential media which have been devised up to the present time for the identification of this bacterial group. Much still remains to be done on the subject.

(e) Work is also in progress on "Number and Kinds of Bacteria Found in Milk Drawn Under Aseptic Precautions." This work was started some time ago but at present some phases are being repeated for purpose of checking the previous findings so that it may be published in the near future.

Both the teaching and the diagnostic laboratories have made numerous laboratory examinations of specimens brought in for diagnosis or for general analysis. Among these might be mentioned, blood samples, body secretions, milk and water samples, together with many other similar materials. Numerous postmortems on domestic animals have been made.

Biological and Live Stock Sanitary Service Laboratories

During the past year, several cooperative projects have been carried on, some of them to completion. One bulletin on Equine Encephalomyelitis was published as No. 369. This study definitely diagnosed the disease in some sections of Maryland, and brought out the fact that mules are less susceptible than horses. Under our field conditions anti-encephalomelitis serum prepared against the Western virus showed no prophylactic value.

The results of several years of study and experimental work on the methods of transmission of the causative agent of blackhead (infectious enterohepatitis) in turkeys have been compiled for publication.

A study of the economics of clean and infected herds (Bang's disease) covering a period of four years, shows that herds free of the disease are distinctly more profitable than infected ones. The work on this project was done in cooperation between the Department of Agricultural Economics and the Live Stock Sanitary Service Laboratory.

A herd survey of reacting animals (Bang's disease) has been made to determine the relation of the titre of agglutination to udder infection and the following conclusions were drawn:

1. A high milk serum agglutination titre was more indicative of udder infection than a high blood serum titre.

2. Milk serum negative for the agglutination test did not indicate freedom from udder infection.

3. Brucella abortus organisms were not found in the milk of any cow whose blood serum did not show agglutinins.

A study of the elimination of Brucella abortus in the feces and urine of infected guinea pigs at time of death, using 100 animals in each study, has been made. This material has been assembled and it is hoped that it will soon be in form for publication.

A similar study to the above is planned using cattle instead of guinea pigs.

Bovine mastitis in relation to Bang's disease in a group of 200 cows has been studied for a year. Monthly examinations by plate and brom-thymol-blue tests, at the farm, and cultural and microscopic tests, at the laboratory have been made. The data are being tabulated and if the results and conditions under which the work was conducted warrant, it will be put in form for publication.

The Vaccination of baby chicks against Fowl Pox: Preliminary work was started in 1934, and this year two groups of 73 baby

chicks have been separately housed. One group was vaccinated by the stick method at the age of 12 days. Provision has been made to separate the two sexes in each group and to maintain them in houses and yards. Observations of vaccination "takes" are made, and the groups are weighed. Exposure of the vaccinated birds will be made at varying periods to check on the degree of resistance, and the length of time the immunity lasts.

A study of so-called "running fits" in dogs was begun at the request of a manufacturer of dog biscuits, one lot of which had apparently produced the condition in dogs. The preliminary trial showed that this lot brought on the symptoms as early as ten days after feeding was begun. Further trials have shown that heating at 250 degrees Fahrenheit for 15 minutes did not prevent the disease. One feeding trial in which control dogs received milk only, and another dog on an equal amount of milk with biscuits added became affected. This experiment apparently indicated that the disease is not due to a deficiency but is probably due to a toxic substance in the food. As material becomes available, more trials are to be carried out together with cultural methods looking to the isolation of an etiological fungal or bacterial agent. Pathological studies of the central nervous system of affected dogs are also contemplated.

Further investigation of Equine Encephalomelitis has been undertaken. During the outbreak of this disease in the late summer and fall of 1934 field trials with a polyvalent antiserum were conducted. Prophylactic injections of this serum during that season apparently cut the losses to less than one per cent, but used as a curative agent it possessed little value. Efforts have been made during the last two winters to prepare a vaccine but the results, thus far, have been unsatisfactory. No work has been done on the inoculation of horses with virus because of lack of buildings properly equipped from the sanitary standpoint. Work on the demonstration of the virus has been confined to guinea pigs. Field trials with commercial vaccine for experimental data are contemplated.

Botany, Plant Physiology and Plant Pathology

Physiological and Biochemical Aspects of Vegetable Storage

The chemical changes that take place in many vegetable crops after harvest determine to a large extent their culinary quality and food value. After-harvest chemical changes in some vegetables cause a rapid deterioration in their quality, while in other vegetables they actually improve the quality. It is therefore essential to know what the after-harvest changes are in each vegetable crop and how they are influenced by external conditions during handling and storage. Respiration in plant food products

that are stored in the living condition is also an important process in relation to the keeping qualities and storage life.

During the past six years an intensive study has been made of the respiratory responses of a large number of different kinds of vegetables under wide variations of storage conditions. This mass of experimental data is being worked over and two manuscripts will be submitted for publication in the near future.

A study was made of the effect of storage temperature on the nitrogenous metabolism of Irish potatoes. The relation of nitrogen metabolism to the rest period was also included in this study. The most important general deduction from all the experimental results is the very slight shifting in the relative proportions of the different nitrogen fractions in potatoes under any conditions during their natural storage life.

The healing of wounds during storage is characterized by a reversion of parenchymatous cells to embryonic cells of the new cork cambium which gives rise to wound periderm. In this reversion to embryonic condition it was found that the protein and basic nitrogen increased at the expense of the amino nitrogen but the amid fraction remained constant. The amino acids rather than the amides were concerned in the regeneration of proteins. The results of this investigation were accepted for publication as Bulletin No. 372.

After-Harvest Changed in Green Snap Beans

An investigation was made of the chemical composition of green snap beans and of the changes that occur in their composition during brief storage periods at cool and warm temperatures. The stage of maturity at which the beans were harvested was an important factor in determining the course and rate of the chemical changes in the beans after harvest. Sugars accumulated in the beans at the expense of the starch. Cold temperature accelerated the digestion of starch. The changes in the relative proportions of soluble pectin and protopectin was associated with changes in crispness at different temperatures.

The translocation of nitrogen from the pods to the beans continued after the beans were harvested. Protein hydrolysis predominated in the pods while protein synthesis occurred in the beans.

The rate of respiration in the beans after harvest was determined and the consumption of sugar by this process was calculated. A manuscript incorporating the results of this investigation has been submitted for publication as a Station bulletin.

Responses of the Tomato in Solution Cultures with Deficiencies and Excesses of Certain Essential Elements

Certain plants exhibit distinctive symptoms of a deficiency of each element in the nutrient solution or in the soil. An intensive study of the deficiency symptoms exhibited by the tomato plant has been carried on for several years. The symptoms of a deficiency of certain elements were found to be so characteristic in the tomato plant that it has been used as a basis for the application of fertilizers to correct symptoms of malnutrition. No distinctive responses could be distinguished between plants treated with excesses of the various elements. The latest results on this project were published in Bulletin No. 375.

Physiological Studies of the Pathogenicity of Fusarium lycopersici Sacc. for the Tomato Plant

The chief purpose of this investigation was to determine the effect of fertilizer treatment upon the susceptibility of the tomato plant to the wilt disease. Plants were grown by the most improved sand culture method and each essential element in the culture solution was varied from a total deficiency up to an abnormal excess. Two varieties were used, Bonnie Best, a susceptible variety and Marglobe, a variety that is relatively resistant under normal growing conditions. The expression of an hereditary resistance or susceptibility to the wilt disease could be modified by the culture solution in which the plants were growing. For example, the natural resistance of the Marglobe variety was greatly decreased when the plants were grown in solutions lacking calcium. Particular attention has also been given to the toxic action of the fungus within the plant and to the inhibitory effect of extracts from a resistant variety to the growth of the fungus in pure cultures. The results of this investigation to date were published in Bulletin No. 374.

A Study of the Soluble Polysaccharides in Sweet Corn

The quality of canned sweet corn depends to a large extent upon the ratio of soluble polysaccharides to starch, but very little is known about the properties of this soluble polysaccharide or about conditions which may influence its amount in sweet corn endosperms. The first part of this study was concerned with the physical and chemical properties of the soluble polysaccharide in Hopeland sweet corn starch. A paper on this phase of the study has been accepted for publication in the Journal of Plant Physiology and it should appear in the autumn of 1935.

Physiology of Cold Hardiness in Red Clover

Unadapted red clover seed has been one of the causes for the reduction in the acreage of red clover sown in the United States.

Red clover varieties differ considerably in their winter hardiness. Usually the percentage of plants that survive the rigors of winter is greater from locally produced seed than from foreign seed. In this study of the physiology of cold hardiness in red clovers, the Ohio was selected as a typical cold-resistant variety, while the French variety was chosen as one easily injured by low temperature. The results of a study of the physical and chemical properties of the roots of these clovers in the cold-hardened and unhardened condition were published as Bulletin No. 370. During the past year the study was extended to include both root and shoot tissues of foreign and domestic red clovers and it is probably the most searching study that has been attempted on the physiology of cold resistance. The French and Ohio red clovers in the unhardened condition were similar in chemical composition and physical measurements but in the cold hardened condition the two varieties were markedly different in physical and chemical properties.

Chromosome Studies in the Genus Ipomoea and the Genus Gladiolus

The project has as its primary purpose the determination of the relation of the wild species of the two genera respectively to the sweet potato and garden gladiolus with the hope of finding closely related types. In the former case it appears that some of those so far examined are related to the sweet potato at least by chromosome number and that is the method employed. Further than this any attempt to hybridize these types has been unsuccessful. In the case of *Gladiolus,* it appears that there are many varying types, with all kinds of differences involving not only chromosomes but flower color, flower arrangement, flowering time, etc. Present results indicate that despite this apparent lack of relationship it is possible to cross any of these on at least some of the garden types. The explanation of this at present is impossible.

Pea Seed Investigations

The breeding of peas resistant to wilt has made it possible for every one in the State desiring seed of such varieties to obtain them. Nearly all of the pea seed planted for canning in Maryland west of the Bay and some on the Eastern Shore came from wilt resistant strains developed at this Experiment Station. One seed firm had 3,000 acres of one strain from this station in

multiplication in the West in 1934 for the use of Maryland canners.

The work on peas including the check-up of seedsmen's lots distributed in the State has improved very greatly the quality of seed stocks delivered to Maryland canners in recent years. These better seed stocks produce not only a higher yielding crop but also a crop that matures uniformly, making it possible for the canners to pack a higher quality product than formerly. This fact has been noticed and commented on by observers generally.

Plant Pathology

With the recent publication of the studies in cytology of the common brown-rot fungus, the project on fruit-rotting sclerotinias is considered completed. This is the fourth bulletin on this project. They furnish a knowledge of the life history and reproduction of this group of fungi as a basis for control methods.

The work on tomato leaf spot remains to be published with a resume of previous work on that project to complete it. This was also a fungus life history study basic to control of an important canning crop disease.

In project J-79, the peach-stone fungus has been grown in pure cultures, in various media, with difficulty, due to fungi and bacteria on the surface of the very large spores. No spores were produced in culture, but what appear to be fruiting bodies are now finally developing. There is considerable variation found under different environmental conditions.

The Annual Plant Disease Survey, Botanical Survey of Maryland and Identification of Plants and Diseases, has been carried on as usual. These information services to other departments and to many Maryland citizens take much time and more time is needed for naming plants in the new arboretum.

The field work on sprays and dusts and other practices for apple scab and tobacco bed diseases was carried on with valuable practical results.

The potato seed maintenance and disease control is of great value and worth continuing from year to year for new methods that are being developed.

The strawberry root disease project on which all our plant pathologists are co-operating has resulted in finding many pathogenic fungi in the roots, the chief ones being Fusarium, Sclerotium or other sterile fungi and Pythium; the latter being the chief seasonal pathogen, causing more marked injury at blossoming time. No decided correlation of disease with soil conditions has been found except that strawberries after strawberries gives more root diseases.

Potato Investigations

Spraying experiments conducted on the potato crop on the Eastern Shore have definitely shown that it is profitable to spray both the early and late crop with Bordeaux Calcium Arsenate.

Results of two years of investigation demonstrate that home grown second crop Irish Cobbler potato seed which has been kept free from diseases can be made to come up and mature just as early as northern grown seed by raising the storage temperature from 40° F. to 65° F. about the middle of January and keeping it at an approximate temperature of 65° F. until it is planted. Home grown seed treated in this manner out yielded northern grown seed in 1934.

Experiments with potato seed maintenance indicate that seed potatoes can be indexed in the spring on the Eastern Shore. Healthy tubers selected as a result of disease readings with the indexed stock can be planted as a late crop in the eastern part of the State. When planted in Garrett County such seed yields just as well as seed grown in the north or in Garrett County.

Two new varieties of potatoes (Katahdin and Chippewa) originated by the U. S. Department of Agriculture are immune to Mosaic. They are equal or superior in quality to varieties now being grown and are giving promising yields.

Without decreasing the vitality of potato seed stock at least five consecutive crops of Katahdin potatoes can be produced on the Eastern Shore in four years by treating the first crop seed with Sodium Thiocyanate soon after it is dug and planting it as a late crop. Such seed produces an uneven stand and does not yield as well as seed from the previous season's crop kept in cold storage. This method is therefore recommended only when a seed grower wishes to multiply his seed stock rapidly.

Experiments on sweet potato plant treatment with organic mercury compounds just prior to setting them out in the field will decrease the percentage of Stem Rot occurring in the field and will increase the yield.

Experiments with sweet potato soil treatment indicate that Sweet Potato Pox can be controlled by applying 200 lbs. inoculated sulphur or 500 lbs. of kainit to the acre on land where the disease has been prevalent.

Experiments with apple spraying indicate that an application of Bordeaux mixture made just before the leaves fall does not inhibit the formation of fruiting bodies of the Apple Scab fungus (Ventunia inequalis Ecke winter) on the fallen leaves.

Entomology

Satisfactory progress has been made on the active projects during the past year. On the codling moth project, the major attention centered on the development of a new spray procedure that will give control of the insect without leaving objectionable residues on the fruit.

The experiments outlined for last year were largely ineffective due to hail injury to the experimental blocks. An enlarged spraying program is being studied this year together with studies on the effect of banding, time and kind of scraping, and disposition of the material scraped from the trees.

The oriental fruit moth work has been published in Bulletin No. 364, but seasonal observations on the biology of the pest and the prevalence of parasites are being continued.

Studies on the plum curculio in the mountain orchards are being continued and it is expected that material will be available for publication during the ensuing year. Studies on the apple seed chalcid and the apple maggot have been made to determine whether it is necessary to start definite projects on these two pests.

Work has been continued on the corn earworm. Two bulletins already have been published and the results of last season's work mimeographed for distribution to the canners. Considerable progress has been made in the study of poison baits, both in the laboratory and in the field for the control of the moths and data has been accumulated in cooperation with the Agronomy Department on the relative susceptibility of various hybrid corns.

Last year's study of the vinegar gnat consisted largely of survey work on the effect of various types of washing and culling on the presence of the maggot in the packed product, the utility of trapping adults in the field and in the factory and personal service to a large number of canners in improving their methods of packing with the view of avoiding infestation. With this season's work on the same insect, we anticipate having sufficient data to warrant the publication of a report.

Insecticidal studies have been made for two seasons on the Mexican bean beetle, particularly with reference to the new rotenone products and pyrethrum as substitutes for the general recommended magnesium arsenate.

Progress has been made on the general insecticidal project in the study of pine oils, pyrethrum and rotenone as repellents for stable flies, the study of pine oils in connection with termite repellency, the study of salts of sulphated alcohols as insecticides, spreaders, and emulsifiers and detergents in fruit washing, and the testing of approximately 20 commercial insecticides against three common greenhouse pests.

Horticulture

Orchard Fruits

Apple varieties which usually are considered annual in bearing habit are too often biennial in Maryland. These apparently can be changed from a biennial bearing condition to an annual bearing condition by use of heavy early thinning. Such heavy thinning entails some reduction in crop and the grower is not easily convinced that he will gain by the procedure. One year's investigation offers the possibility that girdling with a knife-cut or saw-cut in early June can be used with heavy commercial thinning to accomplish the same result as very heavy early thinning without reduction of crop or bad effect on tree or fruit. Girdling by removal of a narrow strip of bark has a deleterious effect on the tree growth. Early heavy thinning combined with girdling promises to add materially to regularity of bearing of many commercially important apple varieties in Maryland.

Nitrogen nutrition of fruit trees in Maryland continues to be outstanding among orchard practices in regard to responses obtained in growth and yield, but continues to present problems for the investigator, and fruit grower.

After fourteen seasons' work it appears quite clear that fall application of nitrogen to apple orchards is a desirable practice. Some more slowly available nitrogen materials give relatively poor responses as spring applications, but are excellent when used in the fall. Fall applications largely avoid the bad effects on maturity and color which may in some seasons result from spring applications, especially with more slowly available materials. A "split" application of nitrogen, applying part in the fall and part in the spring, gave best results in yield and growth, so may be considered the best practice to recommend. Among the nitrogen carriers, the nitrogen-deficient trees will respond best to a quickly available nitrogen until the nitrogen deficiency no longer exists. With trees needing only maintenance of nitrogen, no differences in responses can be shown from various nitrogen sources. These results are of great practical importance in that they demonstrate the manner in which the cheaper forms of nitrogen may be used safely.

Peach pruning investigations show that continuous thinning out of branches on bearing peach trees does not stimulate production of terminal growth. With annual pruning of this type the length of terminal growth becomes less and less. Cutting back to lateral branches has a marked stimulating effect. Hence, thinning out should be reduced to the minimum and cutting back resorted to more than is the practice in order to secure annual high yields.

Fruit washing experiments during the past year demonstrate the relative importance of several important factors affecting

the removal of lead residues. The variety of apple had little effect on the residue carried on the fruit at harvest. Stayman Winesap may be somewhat more difficult to condition than Jonathan, Grimes Golden and Delicious. The addition of fish oil or mineral oil to the first two lead arsenate sprays did not appreciably influence the amount of residue at harvest or its ease of removal. Additions of fish oil or casein-lime spreader to late cover sprays increased slightly the amount of residue at harvest, but did not increase the difficulty of cleaning. Seven cover sprays compared to five greatly increased residues at harvest and difficulty of removal. Residues at harvest were highly correlated with residues after washing with the more ineffective treatments. An increase in acid concentration from 0.5 to 1.5 per cent resulted in an increased removal of approximately 37.5%. The increase in removal from washing 1.5 minutes compared to 0.5 minutes was only 13.5%. Increasing the temperature of the acid bath from room temperature to 100° F. resulted in 17.5% greater removal and from 100° F. to 110° F. in 15% additional. No benefit was obtained with additions of 1% salt (NaCl). Addition of 1% Vatsol increased removal 23% at room temperature and 33% when heated to 100° F. After five month storage, difficulty of removal increased except with acid wetting agent solutions. Arsenic burning (lenticel injury) and heat injury was more pronounced on York Imperial than with other varieties.

Grapes

Thinning of Concord grape clusters before blossoming can be easily accomplished with marked increase in size and compactness of fruit cluster at harvest, as well as an increase in size of berry. Removal of small and straggly flower clusters and reduction of the total number of clusters to 100 or less depending on the vine vigor, seems to be the method to use. The third and fourth flower clusters on a shoot usually make the smallest branches and flower clusters on renewal shoots are often straggly or small, so that the selection of clusters for removal should be based on this knowledge.

Vegetables

Extensive investigations on the factors associated with the occurrence of cracks in tomato fruits have shown that it is possible to reduce severity of cracking by: (1) picking fruits as soon as possible, (2) maintenance of a uniform moisture supply, (3) and growing plants with heavy foliage, or closer planting so as to provide for as much shade as possible. There are slight differences in susceptibility to cracking among present commercial varieties, which would indicate that it may be possible to select a variety which is highly resistant to cracking.

Co-operative work between the Department of Horticulture, the Extension Service, and the Department of Plant Pathology on the selection of uniform, vigorous, high yielding strains of Alaska peas for Maryland canners has been very successful. Repeated tests have shown that HF-30 strains, developed by Professor Temple, and Associated Strain 5 to be outstanding at the present time.

A comparison of certain hybrids with open pollinated stock indicated that the Narrow Grain Hybrid 26x15 was a decidedly superior white type while Golden Cross Bantam was an excellent yellow variety. Stowell's Hybrid 14x5 while not outstanding this season was superior in some respects to the open pollinated stock and is due to receive another trial. The Country Gentleman Hybrid 19x9 did not appear to be adapted to the seasonal conditions, and proved to be inferior in many respects to the open pollinated stock.

Color development in relation to tomato varieties and environmental factors was extensively studied. In general, but slight differences in color were found in fruits of the several varieties studied.

In the field the fruit temperature during the ripening period was found to have a marked influence on the color of the ripened fruit. Heating of the fruits during the day time as results from direct sunlight greatly reduced the final degree of red color attained.

The results secured in this investigation suggest that the color of manufactured tomato products can be improved by (1) careful harvesting in order to leave the fruits on the vine to develop color as long as possible, (2) the use of varieties which naturally produce an abundance of shading foliage and (3) the following of cultural practices which maintain the plants in good foliage throughout the harvest season.

Potatoes

The results from breeding of the potato are of great significance from the standpoint of the future improvement of this crop. In greenhouse tests, several seedlings have been found which are apparently resistant to the potato wilt disease. This disease, particularly in dry seasons, in a serious factor in the profitable commercial production of potatoes in Maryland. To secure varieties that are immune or resistant is, therefore, a possibility that is materially advanced by the discovery of wilt resistant types. Insect resistance is also a factor of economic importance and several strains that are apparently highly resistant to attacks of flea beetles and leaf hoppers have been isolated. The new varieties Chippewa, and Katahdin which are highly

resistant to mild mosaic have received extensive tests throughout the state. The Chippewa is distinctly promising especially in the early potato section. Its culture is being encouraged because, when dug at the same time as Cobbler, it yields equally as well. It, however, is a later variety and when mature yields much more than the Cobbler under average conditions. This variety may be said to have a longer season than Cobbler which permits of greater flexibility in harvesting and marketing, which is often of great value to the commercial grower.

Poultry

During this fiscal year, bulletin No. 367 entitled, "A 'Weigh-Back' System for Feeding Laying Hens," was completed and published. This is a description of the system of feeding that gave such good results in the Egg Laying Contest. The system is of especial advantage to the inexperienced poultryman or the poultry raiser who, for one reason or another, must depend on inexperienced help to do his feeding, because it eliminates necessity for the use of personal judgment in determining amounts to feed.

A drawing and description of the Maryland reel type feeder, and the latest revision of the Experiment Station laying ration are also included in Bulletin 367.

Considerable effort has been expended in a continuation of the study of data collected during the operation of the Egg Laying Contest. Grouping all the Leghorn pens in accordance with their egg production, it has been found that the hens that produced best, consumed the largest amount of mash. The study of the data for the other breeds is not quite complete. The findings from this study will, it is hoped, enable us to revise the laying mash formula in the direction of efficiency in egg production.

General data on consumption of accessory mineral products in the Contest are included in Bulletin 377.

Continuation of the project, breeding for resistance to pullorum disease, gives additional evidence that this disease can be controlled by good management, and that resistance to the disease is an inheritable factor.

A special formula for a broiler ration has been devised and given a feeding test. Better than normal growth was obtained under somewhat difficult conditions, the weather hot and the brooders crowded. A bulletin manuscript is practically completed for publication.

A number of feed tests on allegedly deleterious feeds have been run. As in the past we have not been able to duplicate the troubles suspected of having been caused by the feed.

Considerable emphasis in late years has been placed on hardness in grit for chickens. A machine has been designed during the year for testing for hardness. Of nine samples run in the preliminary test, a pebble grit from Baltimore ranked hardest and a granite grit from Lithonia, Georgia, softest. Granite has a high rating for hardness in standard tests, but it has a tendency to crumble or shatter badly under a "squeezing" test. The machine is described in Bulletin 377 along with considerable other information learned about grit for poultry.

Many feed formulas have been made up during the year for poultry raisers who wish to mix their own rations. The requests come principally from farmers who have home products that they wish to utilize to best advantage. There is so much demand for information of this kind that the formulas already made up are being assembled for possible publication. In many cases direct or indirect reports have attested to the high efficiency of the formulas suggested.

Many minor problems have been worked over and there are many other tests being conducted which have not advanced to the point where conclusions may be drawn.

Seed Laboratory

(*Inspection and Research*)

During the year more samples were received than during any previous like period. We have continued to accumulate "by-product" data of several types that become more valuable as they accumulate. We have co-operated with other seed laboratories both at home and abroad. This has enabled us to keep the standard of our work up to what is expected of state supported agencies of this kind. Seed stocks throughout the State were inspected and the usual number of samples (500) were taken from these stocks. A careful study was made of these samples and the results were given wide distribution early this year. The number of samples submitted to the laboratory during the twelve months' period was 2,647, approximately one-fifth more than were sent to us during the like preceding period.

It has been in connection with many of these samples that we have made our most outstanding contribution in the interest of our farmers and in advancing the technique of seed testing. This practice and the work on our "Purnell" project, "Economic Use of Seeds," both grew out of our realization that the practice, long customary, of reporting the percentage of pure seed and the percentage of germination fell far short of giving the user of seeds the information he needs for their satisfactory and economic use. Seed testing should furnish the plant producer with such information regarding the bulk of seed he proposes

to use as will enable him to judge correctly its usefulness for his particular purpose. The usefulness of a bulk of seed, so far as its characteristics are concerned, will depend upon its freedom from injurious materials and organisms and upon the number of normal plants of the kind wanted that can be produced from a given amount of it under favorable conditions in the soil. In other words, in order to use any lot of seed with assurance that it will give the desired results the planter must know four things. They are:

A. That it is the kind (genus, species, strain) of seed wanted.

B. That is free of seed borne parasites that might prevent the production of a normal crop.

C. That it is free of noxious weed seeds.

D. The number of plant producing seeds per unit weight of the bulk, from this information only can the proper seeding rate be determined.

The number of plant producing seeds per unit weight of the bulk depends upon three things:

1. The per cent of the bulk which is "pure seed" (seed of the kind wanted).

2. The per cent of the "pure seed" which will produce normal plants under favorable conditions in the soil.

3. The size of the "pure seed."

Knowing only the per cent of pure seed and the per cent of the pure seed that produce normal plants under favorable conditions in the soil, which are the two items of the three just enumerated that it has been customary for seed analysts to determine, the user of the seed has had no quantitative data that would enable him to determine the seeding rate required for a satisfactory stand of plants. With the third item of information, the size of the seed, it is possible to determine the number of plant producing seeds per unit weight of the bulk of seed to be planted. The seeding rate for any desired number of plant producing seeds per unit area thus can be calculated. We have found that the number of plant producing seeds per unit weight of many kinds of seeds varies widely with different lots depending upon (1) the per cent of pure seed, (2) the per cent of the pure seed which are plant producing, and (3) the size of the pure seed. In order to get the same number of plant producing seeds per unit area, some lots of red clover seed, for example, can be sown at rates of less than eight pounds per acre, while

many other lots must be sown at rates of more than twelve pounds per acre. Regardless of what the ideal number of plant producing seeds per unit area under any particular given condition may be, the fact remains that such ideal number will be supplied only when the seeding rates of the different lots are made proportional to their respective numbers of plant producing seeds per unit weight. Without knowing the number of plant producing seeds per unit weight, recommendations as to proper seeding rates must be imperical. Knowing the number of plant producing seeds per unit weight, one unknown factor in determining the proper seeding rate (the one for which the seed analyst is responsible) is removed which should make possible the elimination of others still unknown. Without waiting for the solution of such problems, for example, as whether fifty is the proper number of plant producing red clover seeds to be applied per square foot, we believe that certain assumptions which appear to be supported by long established farm practice are justified. On the basis of such assumptions, we have not hesitated to advise farmers as to what we believed to be the proper seeding rate for samples submitted to the laboratory. We think such advice to be of direct positive value to the farmer in that it will enable him to use the amount of seed needed for a good stand of plants without using more than is needed and which would consequently be wasted. In fact, we feel that it is only with information as to the proper seeding rate for a given lot of seed that the seed can be used in a rational, economic way. This laboratory is the pioneer in reporting the results of seed examination on the basis of the ability of the seed to produce plants and giving farmers information on the proper seed rate.

Cooperative Tobacco Production Investigations

The work on tobacco production problems mainly located at Upper Marlboro has consisted of studies concerning methods for securing the maximum production of leaf of the higher grades. The activities include the fertilizer requirements of the crop, cropping systems to be used for best results, breeding and testing of strains giving good yields of high quality leaf, methods for control of destructive diseases of the crop and the relation of the water supply to the quality of the leaf.

The fertilizer investigations deal with various ratios, forms or sources, rates of application and time and manner of application of essential elements including in addition to nitrogen, phosphorus and potassium the elements, calcium, magnesium, sulphur and boron. These studies have definitely established the importance of the four additional elements in the fertilizer mixture on the lighter tobacco soil types of the Southern Maryland area. Fertilizer placement trials indicate that best stands and most

rapid growth of plants result following transplanting when the fertilizer is placed in bands to the side of rather than beneath the plants or mixed with the soil around the plants. Results of tests with different sources and rates of application of nitrogen and potash have been published as Bulletin 358 of the Station.

The cropping systems combined with suitable fertilization used in growing tobacco often have striking effects on the yield and especially the quality of leaf produced, in addition to having an important relation to control of certain soil borne diseases. Extensive tests over a period of years have been made in an attempt to determine the value of the common legumes and other cover crops for the production of high quality tobacco. Except under certain conditions the general tendency of the legumes has been to cause a rapid decline in the quality of leaf produced although in some cases good yields have been obtained. The high quality of leaf produced following a natural weed fallow has called for a close study of the factors involved. The testing of weed cultures consisting of a single species was first undertaken. In the earlier years the weeds were transplanted but during the past year it has been found possible to grow them from seed in the desired locations by harvesting the seed at the proper stage with respect to maturity and seeding them after suitable seed bed preparation. The weeds included in the tests are those commonly occurring in a natural weed fallow in the Maryland area, namely, ragweed (Ambrosia artemisifolia), horseweed (Erigeron species), lamb's-quarters (Chenopodium album), partridge pea (Cassia chamaecrista), wild bean (Strophostyles helvola) and rabbit-foot clover (Trifolium arvense). Pure cultures of these species were tested in comparison with annual sweet clover, lespedeza, bare fallow and natural weed fallow. Tobacco grew unsatisfactorily following lespedeza, annual sweet clover, lamb's-quarters, wild bean and rabbit-foot clover. Good growth resulted following pure cultures of partridge pea, ragweed and horseweed. Best results were obtained with tobacco growing after natural weed fallow consisting of mixtures of the above-mentioned weeds. Experimental data showing the value of natural weed fallow in the cropping system for tobacco have been published as Station Bulletin 363.

The breeding and testing of strains of tobacco adapted to Maryland conditions has been continued during the past year. A new strain of Maryland Mammoth with the standup habit of growth has shown up very well in these trials. A highly resistant strain to black root rot with the standup habit of growth has given leaf of satisfactory quality both in the absence and presence of the disease. This strain produces seed in this latitude. Experiments were continued in the development by breeding and selection of strains of Maryland tobacco having a reduced nicotine content.

Studies concerning methods of control of destructive diseases of the crop have consisted of extensive trials on seed bed treatment for control of downy mildew (blue mold) and wildfire by means of sprays. These trials have yielded promising results and are being continued.

The relation of water supply to the production of high quality leaf is being investigated by the use of solution and pot cultures and irrigation tests in the field. With a liberal supply of water a thinner leaf was obtained which showed a decided improvement in fire holding capacity. This study is closely linked with the effects of the cropping system on water relations in the plant.

Financial Resources and Expenditures

The research work is maintained chiefly by Federal and State appropriations. This is supplemented by farm sales and some small private contributions from time to time for special projects. The Federal acts outline the functions and character of work to be undertaken. The State appropriations are used mostly for general maintenance and executive expenses and to supplement the Federal funds.

The following financial statements give the details as to the appropriations and expenditures:

MARYLAND AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH UNITED STATES APPROPRIATION

Dr.	Hatch Fund	Adams Fund	Purnell Fund
To Appropriations for Fiscal Year 1934-1935	$15,000.00	$15,000.00	$60,000.00
Cr.			
By Salaries	$12,976.79	$13,896.08	$44,115.88
Labor	1,201.15	879.00	4,014.43
Stationery and Office Supplies			38.31
Scientific Supplies	56.65	167.13	2,611.42
Feeding Stuffs	42.00		
Sundry Supplies	141.89	23.76	779.20
Fertilizers	61.79		788.01
Communication Service	4.24	23.88	131.62
Travel	212.10		3,224.65
Transportation of Things	4.00		67.21
Publications	110.76		609.95
Heat, Light, Water and Power			53.67
Furniture, Furnishings and Fixtures			385.58
Library			10.45
Scientific Equipment	126.80	10.15	2,157.09
Tools, Machinery and Appliances			850.81
Livestock			39.09
Buildings and Land	61.83		105.63
Contingent			17.00
Totals	$15,000.00	$15,000.00	$60,000.00

MARYLAND AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH THE
STATION FARM FUND

	Dr.	
Balance June 30, 1934		$7,284.20
Receipts for the year 1934-1935		$12,769.47
Total		$20,053.67
	Cr.	
By Salaries		$201.70
Labor		7,380.57
Stationery and Office Supplies		1.20
Scientific Supplies		149.03
Feeding Stuffs		3,893.56
Sundry Supplies		632.80
Fertilizers		52.03
Communication Service		10.61
Travel Expense		359.68
Transportation of Things		336.87
Publications		
Heat, Light, Water and Power		198.59
Furniture, Furnishings and Fixtures		
Library		7.37
Scientific Equipment		53.28
Livestock		618.55
Tools, Machinery & Appliances		403.50
Buildings & Land		558.94
Contingent		141.92
Total		$15,000.20
Credit Balance		5,053.47
		$20,053.67

MARYLAND AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH
THE STATE APPROPRIATIONS

Dr.	General Fund	Ridgely Farm
Balance June 30, 1934		$463.36
Receipts for year 1934-1935	$41,583.39	3,462.40
Totals	$41,583.39	$3,925.76
Cr.		
By Salaries	$17,766.64	$1,500.00
Labor	8,686.13	1,162.68
Stationery & Office Supplies	253.01	1.01
Scientific Supplies	444.24	
Feeding Stuffs	4,560.38	
Sundry Supplies	1,392.94	117.55
Fertilizer	808.70	155.06
Communication Service	448.55	84.69
Travel Expense	463.23	42.81
Transportation of Things	811.78	2.16
Publications	363.28	108.23
Heat, Light, Water & Power	1,672.66	
Furniture, Furnishings & Fixtures	338.46	56.00
Library	389.58	
Scientific Equipment	3.00	
Livestock	61.00	
Tools, Machinery & Appliances	697.98	71.66
Buildings & Land	2,003.79	237.00
Contingent	418.04	
Totals	$41,583.39	$3,538.85
Credit Balance June 30, 1935		386.91
	$41,583.39	$3,925.76

MARYLAND AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH PUBLIC SERVICE AND REGULATION FUNDS

Dr.	Biological Laboratory	Seed Inspection	Dairy Inspection
Balance June 30, 1934	$1,806.29		
Receipts for year 1934-1935	9,476.70	$6,710.94	$125.00
Total	$11,282.99	$6,710.94	$125.00
Cr.			
By Salaries	$4,598.86	$5,929.99	
Labor	1,323.39	112.00	
Stationery & Office Supplies	83.83	53.36	
Scientific Supplies	112.76	236.35	
Sundry Supplies	2,444.60	20.91	
Communication Service	487.98	135.39	60.00
Travel Expense	1.06		41.00
Transportation of Things	113.37	.75	
Publications	37.75		
Heat, Light, Water & Power	1,195.96	11.04	
Furniture, Furnishings & Fixtures		35.70	
Library		31.80	
Scientific Equipment			262.35
Tools, Machinery & Appliances	173.35	118.50	
Buildings & Land	142.90		
Contingent	101.72	25.15	
Total	$10,817.53	$6,710.94	$363.35
Credit Balance June 30, 1935	465.46		—238.35
	$11,282.99	$6,710.94	$125.00